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TASK FORCES

Task Force 1: Training in Clinical Cardiology

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The training experience in clinical cardiology is fundamental to the development of the specialist in cardiovascular medicine. It should provide a broad exposure to acute and chronic cardiovascular diseases, emphasizing accurate ambulatory and bedside clinical diagnosis, appropriate utilization of diagnostic studies and integration of all data into a well communicated consultation, with sensitivity to the unique features of each individual patient. Active participation in research projects will provide the trainee with further experience in critical thinking and in evaluating the cardiology literature. The knowledge, skills and experience realized by this broad training are essential to providing a solid foundation in clinical cardiovascular medicine before focusing on more specialized areas, which, for some, may become the dominant feature of professional activity. Other goals should be to provide a broad clinical background with an emphasis not only on pathophysiology, therapeutics and prevention, but also on the humanistic, moral and ethical aspects of medicine. Although cardiologists who are highly skilled in diagnostic and therapeutic techniques are necessary, the fundamental requirement for broad clinical insight needed by the consultant in cardiovascular medicine should be emphasized.

General Aspects of Training

Training Institutions

Programs of training in cardiology must be accredited and be offered only in university or university-affiliated institutions that have a residency training program in internal medicine and in cardiovascular disease, fully accredited by the Accreditation Council for Graduate Medical Education (ACGME) or the American Osteopathic Association.

Prerequisites for Training

Training in cardiology should almost always take place after successful completion of at least 3 years of postdoctoral education and training in internal medicine.

Objectives of Training

The general principles enumerated in the General and Special Requirements for Residency Education in Internal Medicine (1) are also applicable to training in cardiology. Cardiology training programs must provide an intellectual environment for acquiring the knowledge, skills, clinical judgment, attitudes and values that are essential to cardiovascular medicine. Fundamental to this training is the provision of the best possible care for each individual patient delivered in a compassionate manner. All physicians undergoing training in cardiology must have and maintain humanistic and ethical attributes (1–4).

The objectives of a training program in cardiology can be achieved only when the program leadership, supporting staff, faculty and administration are fully committed to the educational program and when appropriate resources and facilities are present. Effective graduate education requires an appropriate balance between academic endeavors and clinical service. During training in cardiology, faculty should encourage trainees to cultivate an attitude of scholarship and dedication to continuing education that will remain with them throughout their professional careers. The development of a scholarly attitude includes active participation in and completion of one or more research projects supervised by faculty actively engaged in research, ideally followed by publication in critically reviewed journals. These activities will provide additional experience in critical thinking and will help develop an attitude of scholarship and greater insight into the problems of analyzing and reporting data and other observations obtained from patients.

Role of the Specialist and Duration of Training

Training in cardiology must take into account the role that the cardiovascular specialist is likely to play in the health care delivery system of the future. As a consequence of the aging of the population, the demand for cardiovascular care will increase. Cardiovascular specialists will have to serve as high level expert consultants and procedural specialists, and the training must reflect this expanded role.

The 3-year training program should include a clinical core

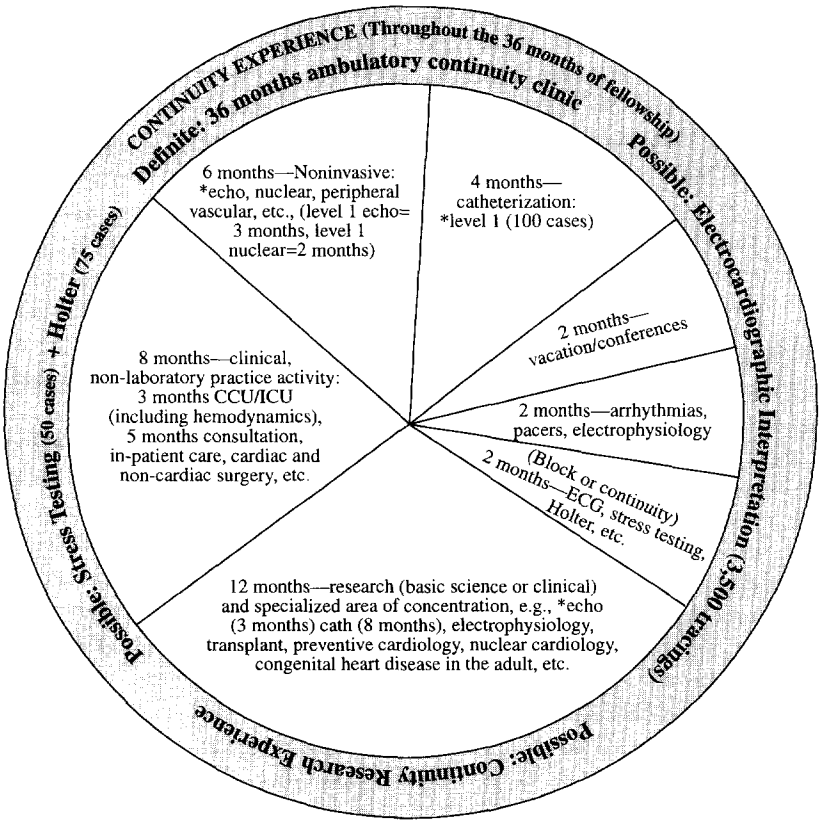

Figure 1. Guidelines for training in adult cardiovascular medicine (1995). Schematic outline of the 36 months of cardiovascular medicine training. **Inner** or "pie" portion of the diagram contains the requirements for the 24-month core clinical rotations as well as the 12-month research and specialization rotation. **Outer ring** contains required or possible continuity experiences that continue throughout the fellowship (e.g., ambulatory clinical experience). CCU = coronary care unit; ECG = electrocardiography; echo = echocardiography; ICU = intensive care unit. *See individual task force reports for complete requirements.

of 24 months with a minimum of 1) 8 months in nonlaboratory clinical practice activities (cardiac consultation, inpatient cardiac care, coronary care unit [3 months], cardiothoracic/cardiovascular surgery, congenital heart disease, heart failure/cardiac transplantation, preventive cardiology); 2) 4 months in the cardiac catheterization laboratory; 3) 6 months in noninvasive imaging (echocardiography and Doppler [minimum 3 months], peripheral vascular studies, nuclear cardiology techniques [minimum 2 months]), nuclear magnetic resonance and other techniques (e.g., cine computed tomography); 4) 2 months (in blocks or equivalent experience) in electrocardiography, stress testing, ambulatory electrocardiographic (ECG) monitoring; and 5) 2 months in arrhythmias, permanent pacemaker management and electrophysiology. A continuing ambulatory care experience for at least a ½ day/week should occur throughout the 3-year training program (Fig. 1).

These time periods are considered to be the minimal time required to learn the indications, interpretative skills, knowledge of complications, risk/benefit and cost/benefit of these procedures. This core 24-month training period does not qualify a trainee as a consultant in cardiovascular disease or as an expert in these technical procedures.

The remaining 1 year in the program should include 6 to 12 months of dedicated research or research combined with focused areas of the individual trainees' interests and future career goals. This may include the acquisition of additional, more intensive training in specific areas of cardiovascular medicine. Trainees often require additional clinical training during the final period of 12 months to be qualified to function properly as consultants in cardiovascular disease and as specialists in cardiology. This latter period permits the trainees to obtain greater experience and supervised training in the clinical management of patients with cardiovascular disease and to obtain additional training in the performance and application of particular diagnostic or therapeutic procedures. Trainees planning an academic career usually need additional training. Vacation time should also be included, as well as time for participation in professional meetings and conferences.

Program Faculty

The program must be conducted under the auspices of a program director who is highly competent in the specialty of cardiovascular disease and fully committed to the training of the cardiovascular specialist. The director of the cardiology training program must be certified by the American Board of Internal Medicine Subspecialty Board on Cardiovascular Disease or possess suitable equivalent qualifications. The director is responsible for the adequacy of the facility, including support resources for the provision of an education of high quality. There should be one full-time equivalent faculty member for each 1½ trainees in the Division (or Section) of Cardiology to guarantee close supervision of all trainees and to allow for the critical evaluation of the program and the competence of the trainees. Each rotation and laboratory should have faculty who supervise the fellows. It is essential that the cardiology pro-

gram director devote sufficient time and effort to the graduate education program and related activities. Cardiology program directors must be full-time faculty members. The program director must have the effective support of the institution(s) where the training takes place so as to provide these educational attributes.

Environment for Training in Clinical Cardiology

Interaction With Other Disciplines

Cardiology training programs must provide an intellectual environment for acquiring the knowledge, skills, clinical judgment and attitudes that are essential to the practice of cardiovascular medicine. Specialists in cardiovascular disease must interact with generalists as well as specialists in other areas and have knowledge of other specialties in order to provide excellent patient care. The ACGME requires at least two other subspecialty training programs and a residency in internal medicine. Thus, the training program should enable the trainee to interact with other disciplines through the availability of collaborating consultants and suitable patients. Close interaction with cardiovascular/cardiothoracic surgery is of particular importance. The overall program must provide advanced training to allow the physician to acquire expertise as a specialist and consultant in cardiology.

Relation to Training in Internal Medicine

Cardiology training programs must provide the opportunity for cardiology trainees to maintain their skills in general internal medicine as well as in those aspects of cardiology that relate to internal medicine. Therefore, the cardiology program must be closely related to the training program in internal medicine, and there must be closely delineated lines of responsibility for the residents and staff in internal medicine and the cardiology trainees. There should be close working contact by the trainees with residents and fellows in other areas, including surgery, anesthesia, radiology, pulmonary disease, pathology, pediatrics and neurology. When appropriate, teaching and supervision by expert faculty in these disciplines should occur.

Required Training Program Resources

The program must have certain minimal resources, including the following:

1. There must be inpatient and outpatient facilities with an adequate number of patients of a wide age range with a broad variety of cardiovascular disorders. Trainees must be supervised and evaluated on every rotation by qualified faculty members when seeing patients in both areas. Outpatient care must be carefully supervised by faculty members.

2. The facility must provide laboratories for cardiac catheterization, electrocardiography, exercise and pharmacologic stress testing, Doppler/echocardiography, ambulatory ECG monitoring and noninvasive peripheral vascular studies. There must be appropriate facilities for cardiac catheterization, angiography and hemodynamic assessment, with adequate numbers of patients undergoing interventional procedures, including coronary angioplasty, atherectomy, stent placement, myocardial biopsy, transvalvular balloon dilation and intraaortic balloon placement (see also Task Forces 2 to 4).

3. Facilities for nuclear cardiology must be available, including ventricular function assessment, myocardial perfusion imaging and studies of myocardial viability (see also Task Force 5).

4. There must be appropriate facilities for the management of patients with arrhythmias, including electrophysiologic testing, arrhythmia ablation, signal-averaged electrocardiography and tilt-table testing as well as the previous evaluation, implantation and assessment of patients with cardiac pacemakers and implantable antiarrhythmic devices and their long-term management (see Task Force 6).

5. Facilities and faculty for training in cardiovascular research, including various basic science modalities, are important (see Task Force 7).

6. There must be modern intensive cardiac care facilities.

7. There must be facilities for cardiac and peripheral vascular surgery and cardiovascular/cardiothoracic surgical intensive care. Close association with and participation in a cardiovascular/cardiothoracic surgical program is an essential component of the cardiovascular training program. This must include active participation in the preoperative and postoperative management of patients with cardiovascular disease. Exposure to cardiac transplantation is strongly recommended (see Task Force 8).

8. There must be facilities and faculty involved in the diagnosis, therapy and follow-up care of patients with congenital heart disease (see Task Force 9).

9. There must be appropriate facilities for the clinical and laboratory assessment of patients with systemic hypertension and peripheral vascular disease (see Task Force 10).

10. There must be facilities for assessment of cardiopulmonary and pulmonary function, cardiovascular radiography and magnetic resonance imaging (MRI).

11. There must be appropriate expertise and instruction in preventive cardiology and risk factor modification, including management of lipid disorders (see Task Force 10).

12. There must be facilities and faculty with knowledge of cardiovascular pathology.

13. There must be facilities, personnel and faculty with expertise in cardiac rehabilitation.

14. There must be other appropriate facilities and resources necessary to accomplish the training, including a comprehensive medical library, facilities for continuing medical education, experimental study design and statistics and quality assurance.

Training Components

An educational clinical cardiovascular disease training program must have the following training objectives and characteristics and must encompass the following areas:

Training in Patient Care and Management

All trainees must be skilled in obtaining a history and performing a complete cardiovascular physical examination. All trainees must be familiar with the role of aging and psychogenic factors in the production of symptoms and the emotional and physical response of patients to cardiovascular disease. They must be familiar with the importance of preventive and rehabilitative aspects of the management of patients with known or potential cardiovascular disease. The trainee should have considerable experience acting as a consultant to other physicians and should have direct patient care responsibility under supervision in proportion to his or her experience and qualifications. Extensive outpatient training is essential.

Training in Understanding, Diagnosis, Prevention and Treatment of Cardiovascular Disease

The trainee must become well educated in pathogenesis, pathology, risk factors, natural history, diagnosis by history, physical examination and laboratory methods, medical and surgical management, complications and prevention of cardiovascular conditions, including coronary artery disease, hypertension, valvular heart disease, congenital heart disease, cardiac arrhythmias, heart failure, cardiomyopathy, involvement of the cardiovascular system by systemic disease, infective endocarditis, diseases of the great vessels and peripheral blood vessels, diseases of the pericardium, pulmonary heart disease, the interaction of pregnancy and cardiovascular disease, cardiovascular complications of chronic renal failure, traumatic heart disease and cardiac tumors.

Training in Intensive Care

The training must include at least 3 months of full-time experience with patients undergoing intensive care for acute cardiovascular disorders and acute coronary care. Exposure to and an understanding of the indications, risks and benefits of cardiac surgery, coronary angioplasty and the various phases of cardiac rehabilitation must be included.

Training in Ambulatory, Outpatient and Follow-Up Care

Continued responsibility for outpatient cardiovascular patient management and consultations must occupy at least ½ day/week for 36 months or an equivalent period. Ambulatory continuity clinic is essential for the duration of training. There should be exposure to a wide age span of patients from adolescence through old age with a spectrum of cardiovascular diagnoses, including postoperative patients, patients with congenital heart disease and patients for evaluation and management related to pregnancy. Additional ambulatory experience in specialty clinics or hospital-based settings is desirable and may include participation in same-day diagnostic or therapeutic procedures.

Training in Electrocardiography

All cardiovascular trainees must be skilled in the interpretation of ECGs. There must be appropriate review and audit and evaluation of their skills. All cardiology trainees must be skilled in the performance and interpretation of exercise ECG tests and ambulatory and signal-averaged ECGs, as described in Task Force 2.

Training in the Cardiac Catheterization Laboratory

There must be direct experience under supervision in a general adult cardiac catheterization laboratory that performs both right and left heart catheterizations. This initial experience in the cardiac catheterization laboratory must emphasize the fundamentals of cardiovascular physiology as it relates to clinical disease, the analysis of hemodynamic records and the interpretation of angiographic images. Such an experience must also emphasize the problems in interpretation and analysis of such data and the importance of quality. All fellows must have adequate training in the principles of radiation safety. The amount of training in the mechanical skills of cardiac catheterization is addressed by Task Force 3. The acquisition of advanced procedural skills is not the primary purpose of the initial exposure of the trainee to the cardiac catheterization laboratory. All trainees must understand indications, risks and benefits of interventional therapeutic procedures, as described in Task Force 3.

Training in Echocardiography

All trainees must participate in the performance of echocardiography and Doppler echocardiography, including a minimum of 3 months of training. All trainees must understand the indications, risks and benefits of transesophageal and stress echocardiography, as well as the principles of evolving techniques such as intravascular ultrasound. Those trainees wishing to perform these latter techniques or to direct an echocardiography laboratory must have additional training, as described in Task Force 4.

Training in Nuclear Cardiology

All trainees should know the general principles, indications, risks and benefits of nuclear cardiovascular procedures, such as radionuclide ventriculography and myocardial perfusion and viability assessment. All trainees must receive basic training in radiation safety. Those trainees wishing to perform these tests must have additional training, as described in Task Force 5.

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Training in Other Advanced Imaging Techniques

All trainees should be aware of major evolving advanced imaging techniques, such as MRI and cine computed tomography (cine-CT).

Training in Cardiac Arrhythmia Device Management

All trainees must understand the diagnosis and management of cardiac arrhythmias. Trainees should know the indications for cardiac arrhythmia devices and the principles of management and follow-up of patients with implanted pacemakers and antiarrhythmic devices, as described in Task Force 6. Participation in implantation is desirable.

Training in Electrophysiology

All trainees must be skilled in the selection of patients for specialized electrophysiologic studies, including arrhythmia ablation. Those wishing to perform these procedures should receive additional training, as described in Task Force 6.

Training in Cardiovascular Research

All trainees should participate actively in research activities. Trainees who anticipate a career in academic cardiology should have additional specialized training, as described in Task Force 7. All trainees should understand clinical trial design and biostatistics.

Training in Heart Failure and Heart Transplantation

All trainees must understand the diagnosis and management of patients with heart failure and of cardiac transplant recipients, as described in Task Force 8.

Training in Congenital Heart Disease in the Adult

All trainees must understand the diagnosis and management of adult patients with and without surgical repair of congenital heart disease, as described in Task Force 9.

Training in Peripheral Vascular Disease

The trainee must develop sound knowledge of the clinical features and treatment of peripheral vascular disease, demonstrate competency in obtaining the history and in performing the physical examination of the arterial and venous systems and should become proficient in selecting and interpreting peripheral angiography, noninvasive imaging, Doppler vascular studies and impedance plethysmography (see Task Force 10).

Training in Related Sciences

The training program should provide an opportunity for continuing education in basic sciences, including those aspects of anatomy, physiology, pharmacology, pathology, genetics, biophysics and biochemistry that are pertinent to cardiology, particularly vascular biology, thrombosis and molecular biology. The availability of educational programs in biostatistics, computer sciences and biophysics is highly desirable. It is essential for trainees to acquire a thorough understanding of the normal physiology of the circulatory system, including the adaptation of the cardiovascular system to exercise, stress, pregnancy, aging and renal and pulmonary abnormalities, and the interpretation of tests of renal and pulmonary function. Training in medical economics, health care systems delivery, clinical decision making, preventive medicine and health care outcomes should also be available.

Training in Related Fields of Medicine

The trainee must gain knowledge and experience in a number of related areas of medicine, including the following:

Magnetic resonance imaging. Familiarity with the cardiovascular applications and interpretations of magnetic resonance images is essential to the training of a cardiovascular fellow. This imaging modality has many existing uses and considerable potential in noninvasive diagnosis. It is recommended that, where available, the fellow devote 2 months of time to magnetic resonance imaging (MRI). To become conversant enough with this methodology to be proficient with interpretation, a 4-month experience is recommended, and to become experienced enough for development and management of an MRI laboratory, a 1-year comprehensive experience is essential.

Radiology. The interpretation of cardiovascular X-ray films, with particular reference to vascular structures and special cardiovascular radiologic procedures.

Surgery. The risks and benefits of cardiothoracic and cardiovascular surgery and the rationale for the selection of candidates for surgical treatment, as well as the natural history and the preoperative and postoperative management of patients with cardiovascular disease and various comorbid conditions.

Anesthesia. Close collaboration with anesthesia colleagues in the preoperative and postoperative management of patients with cardiac disease for cardiac and noncardiac surgery, and cardiac procedures requiring anesthesia (e.g., cardioversion).

Pulmonary disease. A solid knowledge of basic pulmonary physiology in addition to the interpretation of pulmonary and cardiopulmonary function testing, blood gases, pulmonary angiography and radioactive lung scanning methods and experience with the management of patients with acute pulmonary disease.

Obstetrics. A solid knowledge of the interrelations between pregnancy and heart disease, together with experience in the clinical management of patients with heart disease who are pregnant.

Physiology. The physiology of the cardiovascular system, its response to exercise and stress and the alterations produced by disease.

Pharmacology. The pharmacology and interactions of cardiovascular drugs and drugs affecting cardiovascular function.

Pathology. Familiarity with the gross and microscopic pathology of all major forms of heart disease.

Geriatrics. Familiarity with the effects of aging on cardiovascular disease and therapeutics is important.

Training Through Conferences, Seminars, Review of Published Reports and Lectures

There must be regularly scheduled cardiology conferences (e.g., three per week), seminars and review of published data. The participation of the trainees in the planning and production of these conferences is expected. Attendance at medical grand rounds and multidisciplinary conferences is highly desirable, particularly conferences closely related to cardiovascular disease, such as conferences on surgery, radiology and pathology. Visiting professors should provide stimulation and at least informal evaluation and feedback to trainees and faculty.

Teaching and Educational Experience

The trainee must participate directly in the teaching of cardiology and become familiar with the fundamental principles of education, including skills in organization of conferences, lectures and teaching materials. The teaching experience, often by weekly or more frequent core content conferences, must attempt to collate basic biomedical information with the clinical aspects of cardiology, including integration of clinical management principles. Trainees must be familiar with modern concepts of education and effective communication. They must be responsible for teaching and supervising residents in internal medicine as well as medical students, other cardiology trainees and allied health personnel and for working collaboratively with other health care professionals. They must have regularly scheduled experiences in teaching and must be encouraged to attend and participate in national cardiology meetings. Trainees must learn to prepare successfully through self-study and participation in continuing education, using various media, for certification, recertification and credentialing.

Special Procedural Areas

In specific procedural areas of cardiology, minimal training is appropriate for physicians who do not plan to achieve additional qualifications in a given field. Conversely, those physicians who wish to become qualified in specialized areas require additional training, as specified by the individual task forces.

Evaluation and Documentation of Competence

The evaluation of trainees for both clinical and specialized technical skills must be carefully documented. Cardiology program directors must establish procedures for the regular evaluation of the clinical competence of the cardiology trainees. This evaluation must include intellectual abilities, manual skills, attitudes and interpersonal relations as well as specific tasks of patient management, clinical skills (including decision-making skills) and the critical analysis of clinical situations. There must be provision for appropriate feedback of this information to the trainee at regular intervals. Records must be maintained of all evaluations and of the number and type of all laboratory procedures performed by each trainee. Examinations (e.g., Adult Clinical Cardiology Self-Assessment Program [ACCSAP]) at the end of each year of training or each specialized area are strongly encouraged.

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